BREEDING WATERFOWL SURVEYS IN THE LIARD PLAIN AND TESLIN RIVER BASIN, NORTHERN BRITISH COLUMBIA, 1989.

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J. Majiski

Technical Report Series No. 150
Pacific and Yukon Region 1991
Canadian Wildlife Service

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93-01765/

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This series may be cited as:

Breeding Waterfowl surveys in the Liard Plain and
Teslin River Basin, Northern British Columbia, 1989
Nixon, W and J. Majiski
Technical Report Series No. 150. Canadian Wildlife
Service, Pacific and Yukon Region, British Columbia.

Printed on recycled paper

Issued under the Authority of the
Minister of Environment
Canadian Wildlife Service

©Ministry of Supply and Services Canada 1991
Catalogue No. CW69-5/150E
ISBN 0-662-19533-7
ISSN 0831-6481

Copies may be obtained from:
Canadian Wildlife Service
Pacific and Yukon Region
P.O. Box 340,
Delta, British Columbia
Canada V4K 3Y3

Printed on recycled paper

ABSTRACT

Four replicate surveys were flown in May 1989 on selected boreal forest wetlands in the Liard Plain and Teslin River Basin of northern British Columbia. In the 812 km^2 Liard Plain study area, population estimates ranged from 856 (±240) pairs on the fourth survey to 1647 (±424) pairs on the second survey. In the 812 km^2 Liard Plain study area, population estimates ranged from 2089 (±688) pairs on the first survey to 2691 (±1332) pairs on the third survey. Stratifying by wetland size did not improve the precision of the population estimates. Density estimates ranged from 2.0 - 2.2 pairs/km^2 in the Liard Plain to 2.3 - 2.6 pairs/km^2 in the Teslin River Basin. The most common species observed in both study areas were Scaup, Mallard and Goldeneye. Common Loon and Pacific Loon were frequently observed in the Liard Plain.

The precision of the population estimates for the two areas surveyed could be improved by increasing sample size with an extended range helicopter (or fuel caches), but the cost would be much higher. Helicopter surveying is the only feasible method to use in these low density wetlands. Fixed wing transects would require too much time to cover a sufficient number of wetlands, and very few of the wetlands are accessible for roadside surveys. A mapping exercise is recommended to produce realistic breeding population estimates for the Northern Boreal Mountains Ecoprovince of northern British Columbia.

Résumé

Quatre recensements par répétition ont été effectués par les airs en mai 1989 au-dessus de certains terrains marécageux de la forêt boréale de la plaine de la Liard et du bassin de la Teslin au nord de la Colombie-Britannique. Dans la superficie de 812 km^2 recensée au-dessus de la plaine de la Liard, le compte de la population se situait entre 856 paires (±240) au quatrième recensement et 1647 paires (±424) au deuxième recensement. Dans la même zone, le compte de la population se situait entre 2089 paires (±688) au premier recensement et 2691 paires (±1332) au troisième recensement. La stratification par superficie n'a pas amélioré la précision des données. La densité de la population variait entre 2 et 2,2 pairs/km^2 dans la plaine de la Liard et 2,3 et 2,6 pairs/km^2 dans le bassin de la Teslin. Les espèces les plus communément observées lors de ces deux recensements furent le morillon, le canard colvert et le garrot à oeil d'or. Des huarts à collier et des huarts du Pacifique ont souvent été observés dans la plaine de la Liard.

La précision des données démographiques pour les deux zones recensées pourrait être améliorée si on pouvait augmenter la superficie de la zone recensée avec un hélicoptère ayant un plus grand rayon d'autonomie (ou des caches à carburant), mais ceci augmenterait considérablement les coûts de recensement. Le recensement par hélicoptère est la seule méthode pratique pour l'étude des populations de faible densité vivant dans les zones marécageuses. Des transects par avoin demanderaient trop de temps pour qu'on puisse couvrir un nombre suffisant de terrains marécageux et très peu de terrains marécageux sont accessibles par la route. Un exercice de cartographie est recommandé pour faciliter la production d'études démographiques réalistes pour la l'écorégion des montagnes boréales du nord de la Colombie-Britannique.

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INTRODUCTION

Background

In the spring of 1989, Canadian Wildlife Service initiated a surveys of breeding waterfowl to estimate populations in selected areas of northwest British Columbia. The secondary objective of the study was to determine the species composition of waterfowl breeding in these areas. Two study areas were chosen to represent boreal forest wetlands between 600m and 800m elevation; south of Teslin Lake in the headwaters of the Teslin River (referred to herein as the Teslin River Basin) and southwest of Watson Lake in the Liard Plain (Figure 1). Ducks Unlimited Canada (Yukon) provided funding for surveys in the Liard Plain.

Prior to this study, the only detailed survey conducted in this area was in the Teslin River corridor, where the focus was primarily on geese (McEwan and Johnston 1983). Ducks Unlimited did a reconnaissance flight in the B.C. portion of the Teslin River Basin in the summer of 1984. Canadian Wildlife Service conducted staging surveys in the same area in fall 1988 and spring 1989.

This technical report contains a brief review of survey methodologies, and the results of breeding pair surveys conducted in northwest B.C. Total numbers and mean number of birds per wetland are presented for total birds observed as well as for indicated pairs. Breeding population estimates for the two study areas are also presented.

Breeding Pair Survey Methodology

Aerial surveys have been used extensively throughout North America to obtain estimates of waterfowl breeding populations. Transect surveys are often flown over vast wetland complexes, but block surveys or surveys of individual wetlands have also been used (Dennis et. al. 1989).

Most breeding pair surveys are conducted by small fixed wing aircraft, and a sightability correction factor is applied (U.S.F.W.S. and C.W.S. 1987). These correction factors are somewhat standardized, and do not account for the variation in northern boreal forest wetland areas. Some recent survey trials have used helicopter surveys to determine the sightability correction factor for extensive fixed wing surveys (Hines et. al. 1989). The underlying assumption is that surveys done by helicoptor sight all of the birds on a given wetland (Hines et. al. 1989; Ross 1985).

In the past, most surveys were flown once, or at most twice, to include both early breeders (most dabblers) and late breeders (most divers). Population estimates based on a single "point in time" may not accurately reflect the true population, due to annual variation in timing of migration and/or the presence of migrants (ie. non-breeders) in the wetlands surveyed. Ideally, surveys should begin before males desert incubating females and after non-

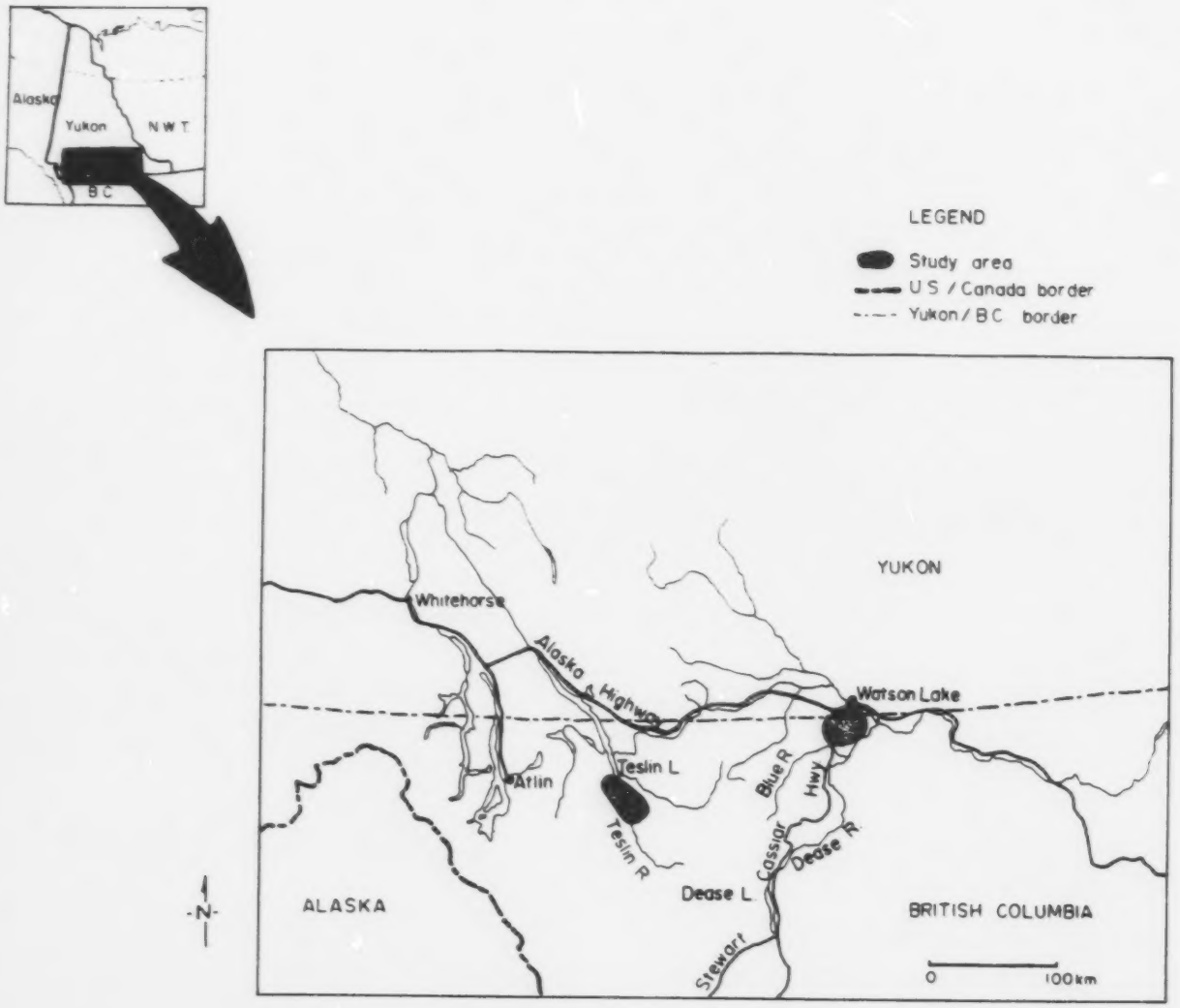

Figure 1. Liard Plain and Teslin River Basin study areas - northwest British Columbia - May 1989.

breeding migrants have passed through the survey area. If only one survey is done, it is difficult to chose a time that is suitable to all species (Ross 1987).

More recently, survey methodologies have been refined to get an accurate estimate of the number of breeding pairs of waterfowl in south central B.C. (McKelvey et al. 1989). The standard proceedure has been to survey several wetlands from the ground repeatedly over a 6 week period, to include both early and late breeders in the estimate. This method of replicate surveys was adapted and applied to wetlands in the boreal forest of northwest B.C. in the spring of 1989.

Study Areas

Both study areas were located in the Northern Boreal Mountains ecoprovince of northern B.C. The Liard Plain study area is part of the Liard Basin ecoregion. The Teslin River Basin study area is found in the northern extent of the Stikine Plateau ecosection (Campbell et al 1990).

Wetlands in the Liard Plain and Teslin River Basin are typically small (less than 15 hectares), shallow and scattered, with varying amounts of emergent vegetation. Some common species of emergent vegetation in the Teslin River Basin include *Carex rostrata*, *Equisetum fluviatile*, and *C. aquatilis*. Floating leaved macrophytes include *Nuphar sp.* and *Polygonum amphibium* (McEwan and Johnston 1983). Willow shrubs are common in wet areas, and upland vegetation is primarily spruce and aspen.

The irregular hummocky terrain in the Liard Plain is characterized by eskers, kettles and abandoned river channels resulting from glacial, fluvioglacial and post-glacial erosion and deposition (Gabrielse 1963). Surficial features in the Teslin River Basin include kame and kettle topography, moraines, shorelines of glacial lakes and esker complexes (Gabrielse 1969). The source of these features is primarily glacial drift and alluvium (Aitken 1959). There are a few larger, deeper lakes found throughout the study areas.

METHODS

Survey Method

Prior to surveying, wetlands were stratified on 1:50,000 topographic maps into 3 different sizes to reduce variance of the sample population (Doyle et. al. 1987; Rutherford and Hayes 1976). The size classification was less than or equal to 1.5 hectares, 1.5 to 15 hectares, and greater than 15 hectares up to 300 hectares. The larger lakes (>300 hectares) were excluded from the survey sample because it was not feasible to get an accurate count of waterbirds. The total land area of each study area was approximately 812 km2 for the Liard Plain and 1175 km2 for the Teslin River Basin. Within each size category, a sample of wetlands were chosen randomly and the most direct flight line was

mapped out. However, the time required to survey each wetland was underestimated. Flight lines were therefore modified and more distant wetlands were omitted once the survey was underway.

Selected wetlands in the Liard Plain and the Teslin River basin were surveyed in a Bell 206 helicopter every 6 days, for a total of 4 replicate surveys between May 11 and 30. In the Liard Plain, wetlands were surveyed on May 11, 17, 23 and 29. Wetlands in the Teslin River Basin were surveyed on May 12, 18, 24 and 30.

Observers were seated right front and right rear in the helicopter. All navigation was done by the observer in the right front using 1:50,000 topographic maps. Each wetland was circled by helicopter, except for a few narrow wetlands which were flown through the middle lengthwise. When large groups of waterfowl were encountered, the helicopter hovered in one place for several seconds. Number, species and sex of birds were recorded into a tape recorder by both observers. The front observer recorded birds seen along shore, while the rear observer recorded birds seen offshore. The number of birds observed were classified as observed pairs, indicated pairs, total males and all birds. "Observed pairs" included territorial pairs and other obviously isolated pairs which were separate from other groups or individuals. "Indicated pairs" included observed pairs plus males in groups of less than 5. "Total males" included lone males, males in groups, and paired males. "Total" birds included all birds seen on a survey. Wetland characteristics were recorded primarily by the rear observer.

Data Analysis

All data were transcribed from tapes to coding sheets and entered on a SAS data base on the Yukon Government mainframe computer. Data summaries and analyses were produced using SAS (SAS Institute 1985).

Means for species and species groups were calculated over the 4 replicate surveys and by wetland. Standard Error as a percent of the mean was used to indicate precision of the estimate. The wetlands sampled were not entirely random, therefore non-parametric analysis of variance was used to determine if sample means were significantly different between surveys. Population estimates for number of indicated pairs of waterfowl and loons breeding in each study area were calculated based on the sample means per wetland. Estimates were produced from stratified samples as well as from all samples regardless of wetland size.

SURVEY RESULTS

Waterfowl populations

Total and mean numbers of waterfowl observed

A total of 57 wetlands were surveyed in the Liard Plain, and 41 wetlands in the Teslin River Basin (Table 1). For both study

Table 1. Number of wetlands surveyed in relation to the total number of wetlands in each study area in northern B.C.

WETLAND SIZE	STUDY AREA					
	Liard Plain			Teslin River Basin		
	number surveyed	total in area	percent surveyed	number surveyed	total in area	percent surveyed
SMALL (<=1.5 ha)	14	67	21	13	189	7
MEDIUM (1.5-15 ha)	30	191	16	23	254	9
LARGE (>15 ha)	13	152	9	5	106	5
TOTAL	57	410	14	41	549	7

areas, the total numbers of birds and mean total number of birds per wetland were highest on the second survey (Tables 2 and 3). The total males and observed pairs observed were also highest on the second survey (Appendix 1). In the Liard Plain, the number of indicated pairs and mean number of indicated pairs per wetland were also highest on the second survey (Table 2 and 4). In the Teslin River Basin, the number of indicated pairs was higher on the third survey due to the high number of Scaup observed (Table 2).

The mean total number of birds observed over all surveys was 291 (S.E.= 42.2) in the Liard Plain and 394 (S.E.= 31.8) in the Teslin River Basin. Fewer wetlands were surveyed in the Teslin River Basin, but a higher number of birds per wetland were observed there (Table 5).

For most species there was no significant difference in numbers observed between surveys. However, in the Teslin River Basin, the total numbers and indicated pairs of Ring-neck Ducks observed between surveys were significantly different (Nonparametric ANOVA $p<0.05$). This may be related to migrant birds that did not remain in the area to breed.

In the Liard Plain, Loon sp. had the most precise estimates (based on S.E. as a percent of the mean) followed by Goldeneye sp. and Mallard (Table 4). In the Teslin River Basin, Scaup had the most precise estimates followed by Mallard and Goldeneye sp. At the species level, even the most precise estimates of mean numbers per wetland were not sufficient to determine a population change of less than 50 percent.

Table 2. Total birds and total indicated pairs observed on surveys in northern B.C. - May 1989.

LIARD PLAIN - MAY 1989
TOTAL NUMBER OF BIRDS OBSERVED ON EACH SURVEY

SPECIES	SURVEY							
	1		2		3		4	
	TOTAL	PAIRS	TOTAL	PAIRS	TOTAL	PAIRS	TOTAL	PAIRS
GREEN-WINGED TEAL	25	8	18	13	8	5	15	12
AMERICAN WIGEON	17	10	5	3	6	3	4	2
BUFFLEHEAD	12	7	26	16	16	9	10	9
BLUE-WINGED TEAL	3	3	2	1	5	3	4	2
CANADA GOOSE	4	2	10	5	6	3	6	3
DABBLER SP.	1	0	0	0	2	1	6	2
DIVER SP.	2	1	3	1	0	0	0	0
DUCK SP.	0	0	4	2	0	0	2	1
GOLDENEYE SP.	30	19	54	25	38	24	34	25
LOON SP.	14	7	48	24	40	20	23	12
MALLARD	53	34	77	63	42	29	36	13
NORTHERN PINTAIL	7	4	0	0	1	1	0	0
NORTHERN SHOVELER	14	7	0	0	3	1	1	1
RING-NECKED DUCK	9	7	22	7	16	10	20	14
SCAUP SP.	77	30	121	62	77	43	34	19
SCOTER SP.	0	0	16	8	32	12	5	4
ALL SPECIES	268	139	406	230	292	164	200	119

TESLIN RIVER BASIN - MAY 1989
TOTAL NUMBER OF BIRDS OBSERVED ON EACH SURVEY

SPECIES	SURVEY							
	1		2		3		4	
	TOTAL	PAIRS	TOTAL	PAIRS	TOTAL	PAIRS	TOTAL	PAIRS
GREEN-WINGED TEAL	1	1	13	9	9	5	6	3
AMERICAN WIGEON	13	7	12	7	16	11	7	5
BUFFLEHEAD	34	19	42	18	32	19	17	9
BLUE-WINGED TEAL	0	0	1	1	8	6	4	2
CANADA GOOSE	14	7	8	4	24	12	8	4
CANVASBACK	5	3	0	0	0	0	0	0
DABBLER SP.	4	2	0	0	2	1	0	0
DIVER SP.	0	0	2	1	2	1	2	0
DUCK SP.	19	0	0	0	0	0	4	2
GOLDENEYE SP.	46	22	40	21	39	20	34	19
LOON SP.	4	2	8	4	7	3	4	2
MALLARD	50	34	41	31	36	21	25	17
MERGANSER SP.	0	0	0	0	4	1	0	0
NORTHERN PINTAIL	7	4	6	4	0	0	3	1
NORTHERN SHOVELER	2	1	20	5	1	1	0	0
OLDSQUAW	0	0	0	0	0	0	2	1
RING-NECKED DUCK	4	2	32	13	0	0	38	17
SCAUP SP.	134	52	178	67	227	92	180	102
SCOTER SP.	0	0	65	0	19	9	13	7
ALL SPECIES	337	156	468	185	426	202	347	191

Table 3. Mean number of total birds observed per wetland on surveys in northern B.C. - May 1989. (Standard Error is expressed as a % of the mean).

LIARD PLAIN - MAY 1989
MEAN NUMBER OF TOTAL BIRDS OBSERVED PER WETLAND (n=57)

SPECIES	SURVEY							
	1		2		3		4	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.4	51	0.3	40	0.1	49	0.3	40
AMERICAN WIGEON	0.3	59	0.1	59	0.1	61	0.1	70
BUFFLEHEAD	0.2	50	0.5	26	0.3	32	0.2	35
BLUE-WINGED TEAL	0.1	74	0.0	100	0.1	59	0.1	70
CANADA GOOSE	0.1	70	0.2	66	0.1	57	0.1	57
DABBLER SP.	0.0	100	0.0	.	0.0	100	0.1	51
DIVER SP.	0.0	100	0.1	74	0.0	.	0.0	.
DUCK SP.	0.0	.	0.1	70	0.0	.	0.0	100
GOLDENEYE SP.	0.5	26	0.9	28	0.7	24	0.6	26
LOON SP.	0.2	36	0.8	17	0.7	18	0.4	26
MALLARD	0.9	28	1.3	23	0.7	24	0.6	35
NORTHERN PINTAIL	0.1	87	0.0	.	0.0	100	0.0	.
NORTHERN SHOVELER	0.2	65	0.0	.	0.1	100	0.0	100
RING-NECKED DUCK	0.2	71	0.4	44	0.3	48	0.4	35
SCAUP SP.	1.4	45	2.1	25	1.4	23	0.6	33
SCOTER SP.	0.0	.	0.3	58	0.6	77	0.1	72

TESLIN RIVER BASIN - MAY 1989
MEAN NUMBER OF TOTAL BIRDS OBSERVED PER WETLAND (N=41)

SPECIES	SURVEY							
	1		2		3		4	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.0	100	0.3	42	0.2	54	0.1	56
AMERICAN WIGEON	0.3	42	0.3	70	0.4	55	0.2	61
BUFFLEHEAD	0.8	29	1.1	39	0.8	45	0.4	47
BLUE-WINGED TEAL	0.0	.	0.0	100	0.1	74	0.1	70
CANADA GOOSE	0.3	35	0.2	48	0.6	38	0.2	48
CANVASBACK	0.1	82	0.0	.	0.0	.	0.0	.
DABBLER SP.	0.1	70	0.0	.	0.0	100	0.0	.
DIVER SP.	0.0	.	0.0	100	0.0	100	0.0	70
DUCK SP.	0.5	100	0.0	.	0.0	.	0.1	70
GOLDENEYE SP.	1.1	28	1.0	27	1.0	37	0.8	30
LOON SP.	0.1	70	0.2	48	0.2	57	0.1	70
MALLARD	1.2	25	1.0	25	0.9	30	0.6	41
MERGANSER SP.	0.0	.	0.0	.	0.1	100	0.0	.
NORTHERN PINTAIL	0.2	57	0.1	74	0.0	.	0.1	100
NORTHERN SHOVELER	0.0	100	0.5	71	0.0	100	0.0	.
OLDSQUAW	0.0	.	0.0	.	0.0	.	0.0	100
RING-NECKED DUCK	0.1	100	0.8	39	0.0	.	0.9	46
SCAUP SP.	3.3	43	4.3	28	5.5	24	4.4	20
SCOTER SP.	0.0	.	1.6	81	0.5	48	0.3	58

Table 4. Mean number of indicated pairs observed per wetland on surveys in northern B.C. - May 1989. (Standard Error is expressed as a % of the mean).

LIARD PLAIN - MAY 1989
MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND (N=57)

SPECIES	SURVEY							
	1		2		3		4	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.1	49	0.2	40	0.1	52	0.2	42
AMERICAN WIGEON	0.2	55	0.1	57	0.1	57	0.0	70
BUFFLEHEAD	0.1	50	0.3	28	0.2	31	0.2	35
BLUE-WINGED TEAL	0.1	74	0.0	100	0.1	57	0.0	70
CANADA GOOSE	0.0	70	0.1	66	0.1	57	0.1	57
DABBLER SP.	0.0	.	0.0	.	0.0	100	0.0	70
DIVER SP.	0.0	100	0.0	100	0.0	.	0.0	.
DUCK SP.	0.0	.	0.0	70	0.0	.	0.0	100
GOLDENEYE SP.	0.3	27	0.4	24	0.4	24	0.4	24
LOON SP.	0.1	36	0.4	17	0.4	18	0.2	26
MALLARD	0.6	26	1.1	23	0.5	29	0.2	38
NORTHERN PINTAIL	0.1	79	0.0	.	0.0	100	0.0	.
NORTHERN SHOVELER	0.1	65	0.0	.	0.0	100	0.0	100
RING-NECKED DUCK	0.1	65	0.1	41	0.2	48	0.2	37
SCAUP SP.	0.5	44	1.1	25	0.8	23	0.3	34
SCOTER SP.	0.0	.	0.1	63	0.2	70	0.1	70

TESLIN RIVER BASIN - MAY 1989
MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND (N=41)

SPECIES	SURVEY							
	1		2		3		4	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.0	100	0.2	49	0.1	51	0.1	56
AMERICAN WIGEON	0.2	40	0.2	73	0.3	58	0.1	59
BUFFLEHEAD	0.5	28	0.5	33	0.5	43	0.2	46
BLUE-WINGED TEAL	0.0	.	0.0	100	0.1	82	0.0	70
CANADA GOOSE	0.2	35	0.1	48	0.3	38	0.1	48
CANVASBACK	0.1	74	0.0	.	0.0	.	0.0	.
DABBLER SP.	0.0	70	0.0	.	0.0	100	0.0	.
DIVER SP.	0.0	.	0.0	100	0.0	100	0.0	.
DUCK SP.	0.0	.	0.0	.	0.0	.	0.0	70
GOLDENEYE SP.	0.5	28	0.5	27	0.5	36	0.5	32
LOON SP.	0.0	70	0.1	48	0.1	56	0.0	70
MALLARD	0.8	25	0.8	26	0.5	31	0.4	46
MERGANSER SP.	0.0	.	0.0	.	0.0	100	0.0	.
NORTHERN PINTAIL	0.1	60	0.1	78	0.0	.	0.0	100
NORTHERN SHOVELER	0.0	100	0.1	51	0.0	100	0.0	.
OLDSQUAW	0.0	.	0.0	.	0.0	.	0.0	100
RING-NECKED DUCK	0.0	100	0.3	37	0.0	.	0.4	29
SCAUP SP.	1.3	28	1.8	33	2.4	27	2.5	22
SCOTER SP.	0.0	.	0.0	.	0.2	63	0.2	50

Table 5. Mean number of birds per wetland for each survey in northern B.C. - May 1989.

AREA	SURVEY	TOTAL BIRDS		INDICATED PAIRS	
		mean	S.E. as % of mean	mean	S.E. as % of mean
LIARD PLAIN (n=57)	1	4.7	24	2.4	22
	2	7.1	14	4.0	13
	3	5.1	17	5.1	15
	4	3.5	15	3.5	14
TESLIN RIVER BASIN (n=41)	1	8.2	21	3.8	16
	2	11.4	21	4.5	18
	3	10.3	23	4.9	24
	4	8.4	17	4.6	18

Population estimates for waterfowl and loons

Indicated pairs were used to calculate the estimated breeding population in order to exclude larger groups of non-breeders (ie. migrants) from the estimate. Species observed in small numbers on only one of four surveys may also be non-breeders, but this only occurred with Canvasback in the Teslin River Basin.

Based on the sample means of indicated pairs per wetland, regardless of wetland size, the overall population estimate for waterfowl and loons ranged from 856 to 1647 pairs in the Liard Plain and from 2089 to 2691 pairs in the Teslin River Basin study areas (Table 6). The population estimates using stratified samples were slightly higher, but in most cases stratifying by wetland size did not improve the precision of the estimate (Table 6). Based on these estimates, the density of indicated breeding pairs in the Liard Plain was approximately 2.0 to 2.2 pairs/km2 compared to 2.3 to 2.6 pairs/km2 for the Teslin River Basin. The estimated breeding pair density of 2.3 to 2.6 pairs/ km2 in the Teslin River Basin was only slightly higher than the 2.1 pairs/km2 observed in the Kawdy Plateau directly to the southeast (Hawkings and Majiski 1991).

Waterfowl distribution

Relationship between waterfowl and wetland characteristics

Small waterbodies generally had the lowest mean number of birds per wetland and large waterbodies had the highest mean number of birds per wetland both for total birds (Table 7) and number of indicated pairs observed (Table 8). The large standard errors associated with these mean values is related in part to the small sample size of waterbodies within each size category.

Table 6. Population estimates for indicated pairs using wetlands stratified by size vs. all wetlands in each study area.

LIARD PLAIN (sampled wetlands n=57, N=410):

SURVEY	SAMPLE TYPE	POPULATION ESTIMATE	S.E.	S.E. as % of ESTIMATE
1	stratified	1020.8	233.6	23%
	unstratified	999.8	223.9	22%
2	stratified	1816.8	247.0	14%
	unstratified	1647.2	212.2	13%
3	stratified	1347.4	234.0	17%
	unstratified	1179.6	185.9	16%
4	stratified	865.0	133.3	15%
	unstratified	855.9	119.8	14%

TESLIN RIVER BASIN (sampled wetlands n=41, N=549):

SURVEY	SAMPLE TYPE	POPULATION ESTIMATE	S.E.	S.E. as % of ESTIMATE
1	stratified	2179.3	355.7	16%
	unstratified	2088.9	344.1	16%
2	stratified	2676.5	513.2	19%
	unstratified	2490.6	459.7	18%
3	stratified	3064.4	730.6	24%
	unstratified	2691.4	666.0	25%
4	stratified	2765.1	453.3	16%
	unstratified	2557.5	466.7	18%

Table 7. Mean number of total birds observed per wetland in small (<=1.5 ha) medium (1.5 - 15 ha) and large (>15 ha) wetlands surveyed in northern B.C. - May 1989. (Standard Error is expressed as a % of the mean).

LIARD PLAIN - MAY 1989
MEAN NUMBER OF TOTAL BIRDS OBSERVED PER WETLAND
IN RELATION TO WETLAND SIZE

SPECIES	WETLAND SIZE					
	SMALL		MEDIUM		LARGE	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.2	54	0.3	42	0.5	34
AMERICAN WIGEON	0.0	.	0.2	47	0.2	41
BUFFLEHEAD	0.2	48	0.3	19	0.3	45
BLUE-WINGED TEAL	0.0	100	0.1	49	0.1	60
CANADA GOOSE	0.1	70	0.1	40	0.2	65
DABBLER SP.	0.1	60	0.0	100	0.1	70
DIVER SP.	0.0	.	0.0	60	0.0	.
DUCK SP.	0.0	.	0.0	70	0.0	100
GOLDENEYE SP.	0.4	34	0.8	18	0.8	27
LOON SP.	0.0	.	0.7	13	0.8	18
MALLARD	0.6	41	0.9	18	1.3	23
NORTHERN PINTAIL	0.0	100	0.0	100	0.0	100
NORTHERN SHOVELER	0.0	100	0.1	59	0.0	.
RING-NECKED DUCK	0.1	45	0.4	30	0.3	47
SCAUP SP.	1.5	41	1.2	21	1.6	30
SCOTER SP.	0.1	79	0.1	66	0.8	65

TESLIN RIVER BASIN - MAY 1989
MEAN NUMBER OF TOTAL BIRDS OBSERVED PER WETLAND
IN RELATION TO WETLAND SIZE

	WETLAND SIZE					
	SMALL		MEDIUM		LARGE	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.2	52	0.1	36	0.3	73
AMERICAN WIGEON	0.2	40	0.3	41	0.4	71
BUFFLEHEAD	0.4	35	0.8	22	1.8	42
BLUE-WINGED TEAL	0.0	.	0.1	48	0.0	.
CANADA GOOSE	0.3	36	0.4	30	0.3	55
CANVASBACK	0.0	.	0.0	100	0.0	100
DABBLER SP.	0.0	.	0.0	100	0.2	69
DIVER SP.	0.0	.	0.1	52	0.0	.
DUCK SP.	0.0	.	0.0	100	1.0	98
GOLDENEYE SP.	0.5	30	0.7	17	3.5	23
LOON SP.	0.0	.	0.0	70	0.9	26
MALLARD	0.6	32	1.0	19	1.5	27
MERGANSER SP.	0.0	.	0.0	.	0.2	100
NORTHERN PINTAIL	0.0	.	0.1	45	0.2	100
NORTHERN SHOVELER	0.0	100	0.1	59	0.8	88
OLDSQUAW	0.0	.	0.0	100	0.0	.
RING-NECKED DUCK	0.6	66	0.4	28	0.5	49
SCAUP SP.	2.0	54	4.9	15	8.3	26
SCOTER SP.	0.0	.	0.2	52	4.1	62

Table 8. Mean number of indicated pairs observed per wetland in small (<=1.5 ha) medium (1.5 - 15 ha) and large (>15 ha) wetlands surveyed in northern B.C. - May 1989. (Standard Error is expressed as a % of the mean).

LIARD PLAIN - MAY 1989
MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND
IN RELATION TO WETLAND SIZE

SPECIES	WETLAND SIZE					
	SMALL		MEDIUM		LARGE	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.1	61	0.1	32	0.4	34
AMERICAN WIGEON	0.0	.	0.1	48	0.1	39
BUFFLEHEAD	0.1	46	0.2	20	0.2	45
BLUE-WINGED TEAL	0.0	100	0.0	49	0.1	60
CANADA GOOSE	0.0	70	0.0	40	0.1	65
DABBLER SP.	0.0	100	0.0	.	0.0	70
DIVER SP.	0.0	.	0.0	70	0.0	.
DUCK SP.	0.0	.	0.0	70	0.0	100
GOLDENEYE SP.	0.3	34	0.5	15	0.4	26
LOON SP.	0.0	.	0.3	13	0.4	18
MALLARD	0.3	39	0.6	20	0.9	25
NORTHERN PINTAIL	0.0	100	0.0	100	0.0	100
NORTHERN SHOVELER	0.0	100	0.1	58	0.0	.
RING-NECKED DUCK	0.1	43	0.2	31	0.2	47
SCAUP SP.	0.8	33	0.6	22	0.7	24
SCOTER SP.	0.0	100	0.0	57	0.3	58

TESLIN RIVER BASIN - MAY 1989

SPECIES	WETLAND SIZE					
	SMALL		MEDIUM		LARGE	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.1	61	0.1	34	0.1	73
AMERICAN WIGEON	0.1	39	0.2	43	0.3	73
BUFFLEHEAD	0.2	37	0.4	21	1.1	40
BLUE-WINGED TEAL	0.0	.	0.1	55	0.0	.
CANADA GOOSE	0.1	36	0.2	30	0.1	55
CANVASBACK	0.0	.	0.0	100	0.0	100
DABBLER SP.	0.0	.	0.0	100	0.1	69
DIVER SP.	0.0	.	0.0	70	0.0	.
DUCK SP.	0.0	.	0.0	100	0.0	100
GOLDENEYE SP.	0.3	29	0.4	18	1.8	24
LOON SP.	0.0	.	0.0	70	0.4	25
MALLARD	0.4	33	0.7	21	1.2	27
MERGANSER SP.	0.0	.	0.0	.	0.0	100
NORTHERN PINTAIL	0.0	.	0.1	46	0.1	100
NORTHERN SHOVELER	0.0	100	0.0	57	0.1	73
OLDSQUAW	0.0	.	0.0	100	0.0	.
RING-NECKED DUCK	0.1	74	0.3	28	0.3	49
SCAUP SP.	0.5	37	2.2	16	4.8	26
SCOTER SP.	0.0	.	0.1	58	0.3	55

In the Liard Plain, the mean number of total birds and indicated pairs per wetland in wetlands with emergent vegetation present was slightly higher than in wetlands with sparse emergent vegetation (Tables 9 and 10). In the Teslin River Basin, the opposite was true.

Species Composition

The most common species observed in both study areas were Scaup, Mallard and Goldeneye (Table 1). Loons were more common in the Liard Plain than in the Teslin River Basin. This may be related to the fact that a greater proportion of large (and usually deeper) wetlands were surveyed in the Liard Plain. Smaller wetlands would not have the food base required for loons. In both study areas, Common Loons were observed with twice the frequency of Pacific Loons.

Other divers commonly observed in both areas included Bufflehead and Ring-necked Ducks. Other dabblers commonly observed included American Green-winged Teal and American Wigeon. Surf Scoters were present in both areas but not seen on all surveys. Canada Geese were appeared in small numbers on each survey.

The species composition observed in the Liard Plain and Teslin River Basin was similar to that of two boreal forest areas surveyed in southern Yukon (Johnston et al. 1985; Nixon et al. (in prep.)). Other boreal forest wetlands surveyed in southern Yukon indicate that American Wigeon are more common than Mallard (Nixon 1989; Mossop (in prep)). In all other boreal forest wetlands surveyed in southern Yukon, Scaup were consistently the most common species observed.

Habitat

Larger lakes in the survey area were still up to 90% ice covered when the surveys commenced May 10, but were ice free by May 16. Most of the surveyed wetlands were ice free on May 10, with the exception of some large wetlands, and a few deeper potholes in the medium and small size category (Appendix 2).

Although our collection of data on habitat characteristics was incomplete, the surveyed wetlands were classified to the level of subclass under the Cowardin system (Cowardin et al 1979). This system is very flexible in that more than one system, class or subclass can be applied to a single wetland (Tables 11 and 12). Wetlands with a variety of characteristics or "transition zones" can be classified without loss of unique features. Most wetlands surveyed had some persistant emergent vegetation (primarily sedges) present along the shoreline as illustrated in Figure 2. Other wetlands had little or no persistant emergent vegetation (Figure 3).

Table 9. Mean number of total birds observed per wetland in relation to the presence of emergent vegetation - northern B.C. - May 1989. (Standard Error is expressed as a % of the mean).

LIARD PLAIN - MAY 1989
MEAN NUMBER OF TOTAL BIRDS OBSERVED PER WETLAND
IN RELATION TO EMERGENT VEGETATION

SPECIES	EMERGENT VEGETATION			
	PRESENT		SPARSE	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.3	28	0.2	46
AMERICAN WIGEON	0.1	34	0.2	69
BUFFLEHEAD	0.3	21	0.2	31
BLUE-WINGED TEAL	0.1	36	0.0	.
CANADA GOOSE	0.1	42	0.1	49
DABBLER SP.	0.0	46	0.0	100
DIVER SP.	0.0	70	0.0	100
DUCK SP.	0.0	70	0.0	100
GOLDENEYE SP.	0.7	17	0.7	20
LOON SP.	0.5	15	0.8	16
MALLARD	1.0	15	0.6	35
NORTHERN PINTAIL	0.0	70	0.1	100
NORTHERN SHOVELER	0.0	74	0.2	71
RING-NECKED DUCK	0.3	23	0.2	82
SCAUP SP.	1.5	18	0.9	40
SCOTER SP.	0.3	50	0.0	.

TESLIN RIVER BASIN - MAY 1989
MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND
IN RELATION TO EMERGENT VEGETATION

SPECIES	EMERGENT VEGETATION			
	PRESENT		SPARSE	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.2	35	0.2	48
AMERICAN WIGEON	0.2	38	0.4	40
BUFFLEHEAD	0.4	29	1.2	23
BLUE-WINGED TEAL	0.0	100	0.1	55
CANADA GOOSE	0.3	26	0.4	35
CANVASBACK	0.0	.	0.1	82
DABBLER SP.	0.0	100	0.1	70
DIVER SP.	0.0	74	0.0	74
DUCK SP.	0.0	.	0.3	83
GOLDENEYE SP.	0.7	18	1.3	23
LOON SP.	0.0	100	0.3	30
MALLARD	0.8	19	1.1	22
MERGANSER SP.	0.0	.	0.1	100
NORTHERN PINTAIL	0.1	50	0.1	74
NORTHERN SHOVELER	0.0	70	0.3	75
OLDSQUAW	0.0	100	0.0	.
RING-NECKED DUCK	0.5	47	0.4	29
SCAUP SP.	3.0	24	6.4	10
SCOTER SP.	0.2	50	1.2	40

Table 10. Mean number of total indicated pairs observed per wetland in relation to the presence of emergent vegetation - northern B.C. - May 1989. (Standard Error is expressed as a % of the mean).

LIARD PLAIN - MAY 1989
MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND
IN RELATION TO EMERGENT VEGETATION

SPECIES	EMERGENT VEGETATION			
	PRESENT		SPARSE	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.2	26	0.1	46
AMERICAN WIGEON	0.1	32	0.1	74
BUFFLEHEAD	0.2	20	0.1	31
BLUE-WINGED TEAL	0.1	36	0.0	.
CANADA GOOSE	0.1	42	0.1	49
DABBLER SP.	0.0	57	0.0	.
DIVER SP.	0.0	70	0.0	.
DUCK SP.	0.0	70	0.0	100
GOLDENEYE SP.	0.4	15	0.5	21
LOON SP.	0.2	14	0.4	16
MALLARD	0.7	16	0.3	29
NORTHERN PINTAIL	0.0	70	0.0	100
NORTHERN SHOVELER	0.0	74	0.1	70
RING-NECKED DUCK	0.2	23	0.0	100
SCAUP SP.	0.8	16	0.5	45
SCOTER SP.	0.1	42	0.0	.

TESLIN RIVER BASIN - MAY 1989
MEAN NUMBER OF INDICATED PAIRS OBSERVED PER WETLAND
IN RELATION TO EMERGENT VEGETATION

	EMERGENT VEGETATION			
	PRESENT		SPARSE	
	MEAN	SE AS % OF MEAN	MEAN	SE AS % OF MEAN
AMERICAN GREEN-WINGED TEAL	0.1	40	0.1	46
AMERICAN WIGEON	0.1	43	0.3	41
BUFFLEHEAD	0.2	28	0.7	23
BLUE-WINGED TEAL	0.0	100	0.1	62
CANADA GOOSE	0.1	26	0.2	35
CANVASBACK	0.0	.	0.0	74
DABBLER SP.	0.0	100	0.0	70
DIVER SP.	0.0	100	0.0	100
DUCK SP.	0.0	.	0.0	70
GOLDENEYE SP.	0.4	18	0.7	23
LOON SP.	0.0	100	0.1	29
MALLARD	0.6	20	0.7	23
MERGANSER SP.	0.0	.	0.0	100
NORTHERN PINTAIL	0.1	52	0.1	79
NORTHERN SHOVELER	0.0	70	0.1	52
OLDSQUAW	0.0	100	0.0	.
RING-NECKED DUCK	0.1	39	0.3	29
SCAUP SP.	1.1	21	3.3	17
SCOTER SP.	0.1	63	0.1	50

Table 11. Characteristics of wetlands surveyed in the Liard Plain - May 1989. (Wetland classification according to Cowardin et al. 1979. Most wetlands contain elements of more than one system and class.)

SYSTEM	SUBSYSTEM	CLASS	SUBCLASS	WETLANDS
Lacustrine	Littoral	Unconsolidated bottom	mud or organic	2, 3, 5, 7, 8, 11, 13, 14, 15, 16, 18, 39, 40, 40A, 46, 48, 49A, 50, 51, 54, 54A, 55, 58, 58A, 60, 61, 63, 65A, 65B, 67, 81, 91
	Littoral	Unconsolidated bottom	cobble - gravel	42, 62A, 87a
	Littoral	Unconsolidated shore	cobble - gravel	13, 14, 16, 18, 22, 54, 54A, 63
	Littoral	Aquatic bed	rooted vascular	4, 6, 9, 46, 49, 49A, 62A, 65B, 81A
Palustrine		Unconsolidated bottom	mud or organic	12, 19, 18B, 51, 55A, 49
		Unconsolidated shore	cobble - gravel	12, 55A
		Emergent	persistant	2, 3, 4, 6, 7, 9, 10, 11, 12, 14, 15, 16, 18, 19, 21, 21b, 42, 44, 46, 49, 49A, 51, 52, 55A, 53, 54, 60, 60A, 62, 62A, 62B, 63, 65, 65B, 67, 81, 81A, 81B, 87A, 91
		Moss - lichen wetland	moss	2, 11, 13, 15, 16, 17, 49, 49A, 55, 62B, 65A
		Scrub - shrub wetland	broad leaved deciduous	17, 18, 40
		Forested	dead	41

Table 12. Characteristics of wetlands surveyed in the Teslin River Basin - May 1989. (Wetland classification according to Cowardin et al. 1979. Most wetlands contain elements of more than one system and class.)

SYSTEM	SUBSYSTEM	CLASS	SUBCLASS	WETLANDS
Lacustrine	Littoral	Unconsolidated bottom	mud or organic	10, 11a, 20, 21, 21A, 30, 35, 38B
	Littoral	Unconsolidated bottom	cobble - gravel	30, 34
	Littoral	Unconsolidated shore	cobble - gravel	8, 11A, 17, 19, 21A, 34, 38
	Littoral	Aquatic bed	rooted vascular	10, 10A, 11, 24, 26, 26A, 47, 47A
Palustrine		Unconsolidated bottom	mud or organic	1, 2A, 3, 4, 20, 31, 35, 38A, 38B
		Unconsolidated shore	cobble - gravel	20, 32, 38
		Emergent	persistant	1, 1A, 2, 2A, 3, 4, 5A, 5B, 6, 6A, 8A, 9, 9A, 10, 10A, 18A, 19, 20, 31, 35, 38, 38A, 38B, 40, 41, 47A, 47B
		moss - lichen wetland	moss	6, 6A, 8, 10, 11A, 19, 19A, 21A, 24, 26, 26A, 32, 50

Figure 2. Boreal forest wetland with emergent vegetation present along the perimeter.

Figure 3. Boreal forest wetland with steeply sloping shoreline and no emergent vegetation.

CONCLUSIONS AND RECOMMENDATIONS

A larger sample size would be required to reduce the variance to a level where population changes could be detected. Given the present precision in estimates, a population change of 25% to 50% would be necessary before a significant change could be detected. The 4 replicate surveys conducted during this study required a total of 22.5 helicopter hours and 24 person days. In both study areas, it would be difficult to increase the sample size without major expense because of the limited range of the helicopter. However, survey times could be increased with fuel caches, or extended range helicopters. Helicopter surveying is the only feasible method to use in these low density wetlands. Fixed wing transects would require too much time to cover a sufficient number of wetlands, and very few of the wetlands are accessible for roadside surveys.

The estimated mean number of pairs per wetland determined from these surveys could be applied to other boreal forest areas of northern B.C. An estimate of the number of waterbirds breeding in low elevation boreal forest wetlands could be calculated using the total number of wetlands found on topographic maps and/or satellite imagery. Similar breeding population estimates could be calculated for high elevation wetlands using the density estimates calculated by Hawkings and Majiski (1991). The Northern Boreal Mountains Ecoprovince (Campbell et al. 1990) would provide a logical boundary for such an exercise.

ACKNOWLEDGEMENTS

Ducks Unlimited Canada (Yukon) provided funding for surveys in the Liard Plain study area. John Smith (CWS Delta) provided comments on the original survey design. Thanks to Claude Marchand of Frontier Helicopters Ltd. (Watson Lake) and Norm Graham of Capital Helicopters Inc. (Atlin) for very capable piloting. James Hawkings and Don Russell (CWS Yukon) provided comments on early drafts.

LITERATURE CITED

Aitken, J.D. 1959. Atlin map Area. B.C. (104 N). GSC Memoir 307.

Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, M.C.E. McNall. 1990. The Birds of British Columbia. Royal British Columbia Museum in association with Environment Canada, Canadian Wildlife Service.

Cowardin, L.M., V. Carter, F.C. Golet and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Fish and Wildlife Service. U.S. Dept of the Interior. 131 pp.

Dennis, D.G., G.B. McCullough, N.R. North and B. Collins. 1989. Surveys of breeding waterfowl in southern Ontario, 1971-87. Progress Notes No. 180. Canadian Wildlife Service, 4 pp.

Doyle T.J., M.A. Spindler, and K.F. Hall. 1987. Estimation of waterbird populations on the Selawik National Wildlife Refuge. Selawik National Wildlife Refuge Progress Report. 87-1.

Gabrielse, H. 1963. McDame map area, Cassiar District, B.C. GSC Memoir 319.

Gabrielse, H. 1969. Geology of the Jennings River map area. B.C. (104 O). Paper 68-55.

Hines, J.E., R.W. Cole, A. Brazda, B. Conant, and J. Goldsberry 1989. Correcting for visibility biases in aerial surveys of boreal forest ducks. Final progress report. Unpublished.

Johnston, W.G., J.J Majiski, D.J. Petkovitch and J.L. Valette. 1985. Waterfowl and invertebrate productivity investigations in riparian wetlands adjacent to the Dezadeash River, southern Yukon. Northern Biomes Technical Report No. 1. 76 pp.

McEwan, C.A. and W.G. Johnston 1983. Inventory of Canada Geese and other waterfowl within the Yukon River basin. June - August 1983. for Canadian Wildlife Service, Pacific and Yukon Region. Yukon River Basin Study. Project Report: Wildlife No.5b.

McKelvey, R.W. 1989. 1989 Waterfowl pair surveys. Unpublished report to contributors. CWS. Delta.

Mossop, D.H. (in prep) Survey of the Waterbird Populations of the Needlerock Wetlands, Yukon 1985-87. Dept. of Renewable Resources, Gov't of Yukon.

Nixon, W. 1989. An assessment of waterfowl habitat and

distribution of waterfowl in the Kluane Planning Region. Wetland Research in the Kluane Region, Greater Kluane Land Use Plan. 45pp.

Nixon, W. J. Majiski and J. Hawkings (in prep). Waterfowl Surveys along the Alaska Highway, southern Yukon, spring and summer 1989, and suggestions for an annual trend survey. Draft Report. Canadian Wildlife Service, Whitehorse, Yukon.

Ross, R.K. 1985. Helicopter vs. ground surveys of waterfowl in the boreal forest. Wildl. Soc. Bull. 13:153-157.

Ross, R.K. 1987. Interim report on waterfowl breeding pair surveys in northern Ontario, 1980 - 83. Progress Notes No. 18, Canadian Wildlife Service, 9 pp.

Rutherford, W.H. and C.R. Hayes. 1976. Stratification as a means for improving waterfowl surveys. Wildl. Soc. Bull. Vol. 4 No. 2:74-78.

SAS Institute. 1985. SAS User's Guide: Basics, version 5 edition. Cary, N.C.: SAS Institute Inc. 1290 pp.

U.S.F.W.S and C.W.S. 1987. Standard Operating Procedures for aerial waterfowl breeding ground population and habitat surveys in North America.

APPENDIX 1. Total birds, total males, indicated pairs and observed pairs recorded on each of 4 surveys in the Liard Plain, northern B.C. - May 1989.

LIARD PLAIN - MAY 1989

SPECIES	SURVEY															
	1				2				3				4			
	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. PAIRS	OBS. PAIRS
GREEN-WINGED TEAL	25	17	8	5	18	13	13	5	8	5	5	3	15	12	12	2
AMERICAN WIGEON	17	10	10	7	5	3	3	2	6	3	3	1	4	2	2	2
BARROW'S GOLDENEYE	20	13	13	7	47	28	21	16	22	14	14	8	30	23	23	5
BUFFLEHEAD	12	7	7	4	26	16	16	6	16	9	9	7	10	9	9	1
BLUE-WINGED TEAL	3	3	3	0	2	1	1	1	5	3	3	2	4	2	2	2
CANADA GOOSE	4	2	2	2	10	5	5	5	6	3	3	3	6	3	3	3
COMMON LOON	14	7	7	7	22	11	11	11	26	13	13	13	12	6	6	6
DABBLER SP.	1	0	0	0	0	0	0	0	2	1	1	1	6	2	2	2
DIVER SP.	2	1	1	1	3	1	1	1	0	0	0	0	0	0	0	0
DUCK SP.	0	0	0	0	4	2	2	2	0	0	0	0	2	1	1	1
GOLDENEYE SP.	10	6	6	4	7	4	4	2	16	10	10	4	4	2	2	1
LOON SP.	0	0	0	0	6	3	3	3	0	0	0	0	1	1	1	0
MALLARD	53	34	34	16	77	63	63	9	42	29	29	10	36	20	13	6
NORTHERN PINTAIL	7	4	4	3	0	0	0	0	1	1	1	0	0	0	0	0
NORTHERN SHOVELER	14	7	7	7	0	0	0	0	3	1	1	0	1	1	1	0
PACIFIC LOON	0	0	0	0	20	10	10	10	14	7	7	7	10	5	5	5
RING-NECKED DUCK	9	7	7	2	22	13	7	5	16	10	10	4	20	14	14	6
SCAUP SP.	77	55	30	10	121	76	62	37	77	43	43	30	34	19	19	13
SCOTER SP.	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
SURF SCOTER	0	0	0	0	14	7	7	5	29	9	9	0	5	4	4	0
WHITE-WINGED SCOTER	0	0	0	0	2	1	1	1	2	2	2	0	0	0	0	0
ALL SPECIES	268	173	139	75	406	257	230	121	292	164	164	93	200	126	119	55

APPENDIX 1 (Continued). Total birds, total males, indicated pairs and observed pairs recorded on each of 4 surveys in the Teslin River Basin, northern B.C. - May 1989.

TESLIN RIVER BASIN - MAY 1989

SPECIES	SURVEY															
	1				2				3				4			
	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. PAIRS	OBS. PAIRS	TOTAL	MALES	IND. PAIRS	OBS. PAIRS
GREEN-WINGED TEAL	1	1	1	0	13	9	9	4	9	5	5	4	6	3	3	3
AMERICAN WIGEON	13	7	7	6	12	7	7	5	16	11	11	3	7	5	5	1
BARROW'S GOLDENEYE	24	12	12	11	30	16	16	14	4	2	2	2	15	10	10	4
BUFFLEHEAD	34	19	19	15	42	26	18	12	32	19	19	9	17	9	9	7
BLUE-WINGED TEAL	0	0	0	0	1	1	1	0	8	6	6	1	4	2	2	2
CANADA GOOSE	14	7	7	7	8	4	4	4	24	12	12	12	8	4	4	4
CANVASBACK	5	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
COMMON LOON	0	0	0	0	4	2	2	2	5	2	2	2	4	2	2	2
COMMON MERGANSER	0	0	0	0	0	0	0	0	4	1	1	1	0	0	0	0
DABBLER SP.	4	2	2	2	0	0	0	0	2	1	1	1	0	0	0	0
DIVER SP.	0	0	0	0	2	1	1	1	2	1	1	1	2	0	0	0
DUCK SP.	19	19	0	0	0	0	0	0	0	0	0	0	4	2	2	2
GOLDENEYE SP.	22	10	10	10	10	5	5	4	35	16	16	12	10	0	0	7
LOON SP.	4	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
MALLARD	50	34	34	11	41	31	31	8	36	27	21	8	25	17	17	4
MERGANSER SP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NORTHERN PINTAIL	7	4	4	3	6	4	4	2	0	0	0	0	3	1	1	0
NORTHERN SHOVELER	2	1	1	1	20	14	5	6	1	1	1	0	0	0	0	0
OLDSQUAW	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1
PACIFIC LOON	0	0	0	0	4	2	2	2	2	1	1	1	0	0	0	0
RING-NECKED DUCK	4	2	2	2	32	21	13	7	0	0	0	0	38	32	17	6
SCAUP SP.	134	85	52	38	178	104	67	56	227	143	92	62	100	126	102	52
SCOTER SP.	0	0	0	0	0	0	0	0	14	4	4	2	6	3	3	3
SURF SCOTER	0	0	0	0	65	34	0	1	0	0	0	0	7	4	4	2
WHITE-WINGED SCOTER	0	0	0	0	0	0	0	0	5	5	5	0	0	0	0	0
ALL SPECIES	337	208	156	110	468	281	185	128	426	259	202	121	347	230	191	100

APPENDIX 2: WETLAND CHARACTERISTICS - NORTHWEST B.C.

LOCATION : LIARD PLAIN
DATE 11-28 MAY 1989
COMMENTS : HELICOPTER SURVEY - BREEDING WATERBIRD POPULATIONS

#	SIZE	EMERGENT VEGETATION % COVER	SPECIES	DISTRIBUTION 1 END	BOTH SHORE LINE	ENTIRE	CLUMPS	AQUATIC BED MARL, ALGAE ROCK	SUBMERGENT VEG SPECIES	%COVER	SHORELINE	UPLAND VEGETATION SHRUBS	SPRUCE OPEN	SPRUCE CLOSED	MIXED ASPEN/POPLAR	SNAGS	BEAVER DAM/HOUSE		SLOPE OF SHORE	H2O COLOUR	COMMENTS
2	>15 ha	flooded in sw corner					Carex clumps	Marl	moss	>50% at edge			closed spruce some standing dead, sw corner			p	1	1	moderate all sides	clear	island with sedge to the east deep in centre, shallow elsewhere
3	med size	<1a	Carex	sedge at 1 end				Marl					closed spruce		some poplar in north	p		1	mod slope	clear	isolated pothole 70% ice cover survey 1
4	<1 5 ha				sedge thin strip				May be Pot sp/ eelgrass	approx 5m band	flooded Carex	flooded willow in sections	closed spruce at perimeter		<5% aspen on shore/mixed further back				mod to north	turbid	small, 40% open water in basin shallow at south edge, channels throughout sedge
5	<1 5 ha	<5% very sparse at edge	Carex					Marl	none seen		flooded spr 20yds border		closed spr to basin		aspen slopes /mixed behind		1 to V	1 old	steep to south	clear	small, ice 85% survey 1 shallow with 1 deep hole slope to north is moderate
6	<1 5 ha	100%	Carex				tussocks to west	Veget-ation			spruce in south		closed							dark	covered with ice and snow for first survey, no open water by survey 3
7	med size	flooded sedge at sw corner			some along shore			Marl dark green	moss other			flooded willow sw end	closed/ flooded sw end		mixed back off shore	lots				clear	bar across the middle 2 deep holes
8	med size							Marl algae				some flooded willow	closed some at shore flooded		mixed behind spruce					clear	shallow
9	med size	70%	Carex		sedge	sedge tussocks			lilies other	5% sparse	sedge willow		closed spr to basin		mixed behind spruce						spruce island in centre deeper water in centre
10	<1 5 ha	100%	flooded sedge					Veget-ation					closed						very low		
11	>15 ha	approx 10%	Carex	meadow at 1 end	some on shore			Marl yellow/ green	moss	40%			closed spruce to shore							clear	shallow water with deep holes several bays and inlets

APPENDIX 2 Continued

#	SIZE	% COVER	SPECIES	EMERGENT VEGETATION DISTRIBUTION 1 END	BOTH	SHORE LINE	ENTIRE	CLUMPS	AQUATIC BED MARL, ALGAE ROCK	SUBMERGENT VEG SPECIES	%COVER	SHORELINE	UPLAND VEGETATION SHRUBS	SPRUCE OPEN	SPRUCE CLOSED	MIXED ASPEN/POPLAR	SNAGS	BEAVER DAM/HOUSE	SLOPE OF SHORE	H2O COLOUR	COMMENTS
12	med size	1-2m n side	Carex sedge						Marl			rocky			closed to shore	mixed behind spruce				clear	25% shallow water centre is deep
13	med size								Marl	moss	75-80%	rocky	flooded willow 2% north shore		closed to shore	mixed behind spruce	p		steep basin	clear	shallow at shore, deep spots 50% deep water, spruce islands
14	>15 ha		sedge	some flooded					5% Marl deep			rocky	flooded willow sedge at 1 end		spruce to shore/n&s	mixed, some on shore-east on n slope		1 old	steep to N	clear	deep lake
15	med size		sedge	meadow 1 end		narrow strip			Marl yellow/ green	moss	50% in deep water				spruce around basin	mixed behind spruce			mod all sides	clear	deep pothole no sub veg around shore
16	>15 ha	some on shore & floating	eelgrass & sedge	flooded NE corner		sedge at east shore			Marl	Carex bottom & moss	<10% Carex	rocky in N			spruce to shore		lots	some	steep to N		large, 2 islands 1 treed, 1 sedge, N end shallow with deep holes, W side shallow
17	<1.5 ha	approx 100%, last survey	Carex							present moss & Carex			flooded willow NE and W		spruce around basin						small pothole in sedge basin 50% water 50% sedge, survey 2 shallow with 1 deep hole
18	>15 ha			1 meadow					Marl	some at shore		some rock	some willow & flooded sedge		closed to basin flooded shore	mixed behind spruce				clear brown bottom	large, many bays & inlets 10% deep water, 1 treed island Small connected pothole surveyed twice
18B	med size	flooded sedge east end				1-2m strip			Marl green bottom	moss stripes follow shore contours					spruce around basin	aspen behind			shallow	clear	missed survey 2 sedge basin, tree island
19	<1.5 ha			meadow to East		thin band			Marl Algae	moss algae			willow to south shore		spruce to shore/open black in N	solid aspen behind spr. in south			moderate slopes	clear lt brown colour	small and shallow wetland
21	med size	10% at outside edge	Carex	swampy at 1 end		tussocks around shore						spruce to E edge			sparse flooded all around	aspen on slopes	P	P	steep to N, mod to south	clear brown colour	
21B	<1.5 ha		Carex			all along shore			Marl yellow bottom			defined by moss			some black at shore/closed behind aspen	aspen at shore			low relief	clear	small and shallow

APPENDIX 2 Continued

#	SIZE	EMERGENT VEGETATION % COVER	SPECIES	DISTRIBUTION 1 END	BOTH	SHORE LINE	ENTIRE	CLUMPS	AQUATIC BED MARL, ALGAE ROCK	SUBMERGENT VEG SPECIES	%COVER	SHORELINE	UPLAND VEGETATION SHRUBS	SPRUCE OPEN	CLOSED	MIXED ASPEN/POPLAR	SNAGS	BEAVER DAM	HOUSE	SLOPE OF SHORE	H2O COLOUR	COMMENTS
22	med size		Carex sedge					some tussocks				no veg rocky-moss	some flooded willow in south	spruce to shore flooded in south		aspen behind spruce	P		1		clear slightly turbid	large, deep wetland
40	med size	2% Carex	some floating			thin strip			Marl 20% is shallow	mossy	80% at only 1 end	dead, floating spr /aspen on shore	willow at SE edge	spr to shore in S Flooded at shore		flooded at N bank	P		1 active	steep in N gentle to the S	clear	isolated some deep holes 2 treed islands snow to survey 3
40A	<1 S ha								Marl, green bottom			spruce to S shore		flooded live & dead in centre		aspen to N some fallen	P			steep to N & S	clear	deep water, dark in spots
59	med size								Marl in shallow centre strips	moss/ other	5% on marl	rocky, moss defines shore steep bank		spruce to shore		mixed behind spruce				moderate	clear	large, many bays and inlets 80-85% deep water. 1 treed isl shallow water on shore
42	<1 S ha	80%	Carex in basin						rock bottom in channel					spruce to basin flooded elsewhere			lots	2 old	1 old	no slope	clear	sedge meadow complex channel throughout
44	med size	40%	Carex basin			some on shore		some tussocks						spruce to basin flooded elsewhere			lots		1		clear green	large basin, lots of bays deep water, treed island
46	>15 ha	30% 1 5m	Carex S shore	meadow at 1 end		all at edge			Marl	moss lily				spruce to shore in N				1 sedge	1 old	low relief	clear	shallow water, 80-85%
48	med size	<5% ea sub veg	Carex			thin strip			Marl/blue green			moss shore		spruce to shore			P		1	slope to to NE	clear	connected to 46 by channel bare slopes, shallow in centre
49	med size	to 5M 50%	Carex	small meadow		thin strip			Marl	sludge/ moss 10% lily	100%			spruce to basin dead in centre		aspen far behind spr.	lots	2	1	slope to N	clear	dams fore wetland-50% shallow flooded into spruce PHOTO#1
49A	med size	40%	sedge Carex			thin strip		centre clumps	Marl/green brown bottom	moss/ lily	50%			closed spruce					1	gentle slope	clear	shallow, bar across wetland
50	med size	<2%	Carex						moss bottom some algae	floating algae				closed spruce to shore								shallow pothole basin
51	<1 S ha	25%	Carex basin						marl algae	floating algae				some around edge		some aspen				slope to N	brown	small flooded pothole beside road. Snow to survey #3

APPENDIX 2 Continued

#	SIZE	EMERGENT VEGETATION % COVER	SPECIES	DISTRIBUTION 1 END	BOTH	SHORE LINE	ENTIRE	CLUMPS	AQUATIC BED MARL, ALGAE ROCK	SUBMERGENT VEG SPECIES	%COVER	SHORELINE	UPLAND VEGETATION SHRUBS	SPRUCE OPEN	SPRUCE CLOSED	MIXED ASPEN/POPLAR	SNAGS	BEAVER DAM/HOUSE	SLOPE OF SHORE	H2O COLOUR	COMMENTS
52	med size	35% of basin	floated sedge/spr					sedge	floating algae			bright orange moss		sperse black at edge spruce to basin						dark water	large sedge basin, 65% water
55	med size	<5% meadow	Carex in south						Marl sludge with moss					spruce to basin dead in meadow				1	slope at N end	clear	W and E sides are deep 70% shallow. Lots of bays
55A	med size	5% & flooded	Carex meadow SE			thin strip		some patches	sand bottom algae shore		low %	rocky and moss		spruce to shore							mostly shallow, little sub. veg 1 tree island with flooded sedge
53	med size	50% at W end	Carex flooded				basin		some algae perimeter			little or undergrowth		open around basin some in centre	some aspen behind spruce						small round wetland Shallow - seedling spruce in centre
56	med size	small %	sedge	patch on N shore		thin strip			Marl/yellow green shallow			rocky		open to N, mostly to shore	scattered aspen			1	steep sides ridge N/NE	clear	small pothole, shallow with deep holes. Submerged island in centre
56A	med size	sedge meadow in South				south strip		some tussocks	Marl/gravel 50% shallow			rocky/moss flooded spr		spruce to shore				2		clear	yellow/green bottom. 3 deep holes many bays, sedge strip to treed island
58	>1.5 ha					flooded in S			some floating algae			flooded spr.		closed to shore some floating dead			P		steep in N to spruce	clear green	treed island, shallow
58A	med size		Carex			v thin on N		some tussocks	Marl	moss				contained by closed spruce to shore					steep to N shallow shore	green	30% deep water couple of deep holes
60A	med size	40 50%	Carex				sedge meadow							flooded black spruce to south			lots				small, deep water
60	>15 ha		Carex	meadow at 1 end					Marl	moss		rocky 1 end		closed to shore some standing dead							large, <30% deep water in centre shallow, treed island with sedge
61	med size	<2%	Carex			shore strip			Marl	none visible				spruce all around					steep in north		isolated pothole, shallow at S/SE
62	>15 ha	20%	sedge	1 flooded meadow					Marl	moss	10%	rocky shore		spruce to shore			P		steep 1/2 N shore	clear	large, shallow with deep spots no sedge in N. 20% shallow
62A	>15 ha	25%	sedge		meadow both ends	shore strip			rocky bott floating algae	lily	low%			spruce to N/S shore				1		clear	long, narrow, deep water
62A EXT	<1.5 ha	25%	basin						moss bottom shallow	moss	100%			closed N/S shore open E/W shore					low relief	clear tea	flooded sedge wetland, connected to 62A via channels 3 waterbodies

APPENDIX 2 Continued

#	SIZE	EMERGENT VEGETATION % COVER	SPECIES	DISTRIBUTION 1 END	BOTH	SHORE LINE	ENTIRE	CLUMPS	AQUATIC BED MARL, ALGAE ROCK	SUBMERGENT VEG SPECIES	%COVER	SHORELINE	UPLAND VEGETATION SHRUBS	SPRUCE OPEN	SPRUCE CLOSED	MIXED ASPEN/POPLAR	SNAGS	BEAVER DAM/HOUSE	SLOPE OF SHORE	H2O COLOUR	COMMENTS
63	<1.5 ha	2a 30%	Carex S/E		at both ends	south strip			marl/ other	moss	100%	rocky in N		closed with fallen/ flooded at shore					steep	clear	pothole, deep centre dark green
65	>15 ha	<10%	Carex							none visible				spruce to shore some flooded			P	1	steep to north	turbid	little shoreline dev. Many bays deep with treed island
65A	med size		flooded basin						Marl/moss yellow/black	moss	50%			open/flooded in south						clear	50% deep water. Some equisetum piles. Oil slick on water in sedge.
65B	med size	20%	Carex	1 end 100% sub veg		thin strip		tussocks in centre	Marl and moss	lilies moss	5-10% bottom			spruce to basin flooded/dead stumps			P	1 1	moderate to shallow		75% shallow bottom. Dam caused flooding 100% veg. cover in one bay
67	med size	50%	flooded sedge basin						vegetation			some moss		spruce to basin				1 1 old	low, hill to N		50% water in basin
81A	>15 ha		2 Carex meadows							lily sparse	5% at shore	rocky in spots		spruce to shore old dead on shore				1 old		brown	deep water
81	>15 ha	90% in basin	Carex Equis etum						algae floating	sub veg	100%			sparse spruce			1	1 large	slope to north		part of a large sedge meadow. Channels-shallow, 10% open water more drainage than wetland.
81B	<1.5 ha	50%	flooded Carex meadow			25m strip			floating algae moss			rocky shore		spruce to basin dead at 1 end of 1 bay				2	no		40% water, 30% flooded spruce/ carex shallow, centre ridge with spruce. beaver ponds btwn 81A B
87A	med size		Carex/moss grass tufts to N/E			thin strip			gravel bottom floating algae				willows between sedge & flood spruce	spruce all around to shore in N flooded E/W					low	dark brown	round
91	med size	50%	Carex to S						sludge with sub veg	lily at edge		rocky shore		spruce to basin+ flooded				2	hill to N		connected to another wetland

APPENDIX 2 WETLAND CHARACTERISTICS- NORTHWEST B C

LOCATION : TESLIN RIVER BASIN
DATE 92 29 MAY 1989
COMMENTS : HELICOPTER SURVEY - BREEDING WATERBIRD POPULATIONS

#	SIZE	EMERGENT VEGETATION: % COVER	SPECIES	DISTRIBUTION: % END	BOTH	SHORE LINE	ENTIRE	CLUMPS	AQUATIC BED: MARL, ALGAE, ROCK	SUBMERGENT VEG: SPECIES	% COVER	SHORELINE	UPLAND VEGETATION: SHRUBS	SPRUCE: OPEN	CLOSED	MIXED ASPEN/POPLAR	SNAGS	BEAVERS: DAM/HOUSE	SLOPE OF SHORE	H2O COLOUR	COMMENTS
1	med size	50-55% 3-4m	Carex	east edge		thin strip	some flooded		sludgy clay algae, dark		low%			spruce to shore north/south			none		low relief	clear	shallow, T-shaped. Not much shoreload on S, some E/W
1A	med size	20% in basin	Carex	meadows E/W							low %			flooded black to S closed					moderate to north	clear tea	shallow
2	<1.5 ha		flooded sedge		sedge	along S shore								spruce on S shore					slope to north	dark brown	V-shaped sedge islands
3	<1.5 ha		sedge basin			some			marl, floating algae yellow buff			well defined by moss		open around basin flooded dead black spruce S end						clear	semi-flooded sedge/spruce complex isolated pothole in sedge shallow
4	med size	50% persists	Carex sedge				basin E side		marl		low%	mixed willow flooded sedge & shore birch W		spruce to basin					low relief	brown colour	no trees W and - flooded birch and Carex. Water 20% of basin
5A	med size		flooded Carex	E/W meadow	& sedge shore									open spruce on 3 sides			<5B		low to N		10% water the rest is Carex between 5B and 5A. Small
5B	<1 ha	75%	flooded Carex		sedge & shore			sedge	marl/brown moss	some Pot ?	50%			flooded open spr.			P		low	clear	connected to 5A. Small marshy meadow
6	<1 ha	>50%	Carex basin							moss	100%			open spruce to N		alder to north			shallow		small, shallow water in sedge black earth, nanega, rocks
8A	med size	60% 40m to spruce	Carex both species				sedge meadow			moss	90 100%		some far off shore	some open sparse spruce					shallow	brown	larger than 6, shallow, isolated in sedge meadow. Black earth, green vegetation
8	>35 ha	small %	Carex			narrow tussocks & S shore				moss other	50%	rocky bottom	some willow in tussocks along shore	spruce to shore			P		slope to shore		large wetland, defined basin surrounded by spruce
8A	med size	flooded to E	Carex			thin strip				where shallow	100%			spruce to shore					low relief		small wetland upstream of 8 not much shoreload, deep water

APPENDIX 2 continued

#	SIZE	EMERGENT VEGETATION: % COVER	SPECIES	DISTRIBUTION: 1 END	BOTH	SHORE LINE	ENTIRE	CLUMPS	AQUATIC BED: MARL, ALGAE, ROCK	SUBMERGENT VEG: SPECIES	%COVER	SHORELINE	UPLAND VEGETATION: SHRUBS	SPRUCE: OPEN	SPRUCE: CLOSED	MIXED ASPEN/POPLAR	SNAGS	BEAVERS: DAM/HOUSE	SLOPE OF SHORE	H2O COLOUR	COMMENTS
9	<1 S ha		sedge Carex				meadow		marl,algae floating		very little			sparse,open spr. thin band		alder behind spruce			flat basin	brown	shallow,in larger flooded basin bottom yellow,lots of orange lichen orange lichen
10	>15 ha	100%	Carex			shore strip	meadow to E		marl,rocky shore	lilies sparse /moss	70% see *			spruce surrounds open @ basin			P	1	1 old	hill to W	clear	large,* 50% shallow,deep centre many bays,channels in sedge. 1 arm no submergent vegetation
10A	<1 S ha	60%	Carex sedge			N shore	flooded meadow			lily	20 30%			spruce @ S shore and to basin			some		flat		small,S shape.Part of river in sedge meadow.flow/channels
11	>15 ha		Carex sedge			hint @ edge	flooded @ S		veg bottom	sparse lily	>50%			spruce to shore			P		1 centre	cliff to NE	clear	large pothole.Sparse open meadow across form cliff.Brown bottom Steep to NE, shallow elsewhere
11A	med size	low %	flooded to S						marl/algae floating*	moss algae		rocks @ N end		spruce to shore open,flooded @ S					steep to E		isolated,shallow *50% is marl with no veg. Boggy to South
17	>15 ha	<1m strip	Carex N end			sparse strip	old meadow					rocky	some willow to shore	thick closed spr. to sh./stand dead			no		mod all sides		large,little shore development
18	med size	low %	Carex sedge				meadow to N					moss to shore		sparse to shore spruce upland		alder behind spr.	P		mod slope N side	turbid brown	isolated defined basin Deep water Meadow to N. No em/sub vegetation.
18A	<1 S ha	<60% tussocks	Carex			entire shore	flooded		can't see bottom			moss/Carex shore	some willow to north	straggly to N/small drunken forest		mixed to S	no			dark brown	isolated in sedge meadow Channel from N.Deep in S,shallow to N
19	med size	10%	Carex sedge			<1m band	1 small meadow		moss			rocks on shore	some willow to east	spr. to shore except part of N/S ends					mod to W low E/N	clear brown	well defined basin-2 semi-circles shallow, standing dead spruce
19A	<1 S ha	>60%	sedge meadow				meadow to E	sedge islands	mossy	Charra? moss				stunted N/S W side open spr.					low all sides		small in sedge meadow,flow from S.Shallow,channels,defined shore.
20	<1 S ha	50% 3 4m	sedge strip						mud/algae green bot.			rocky edge		spruce to basin					upland moderate	clear	water in centre,confined basin small shallow patch,low slope
21	med size	small %	sedge @ S			just @ shore			mucky					spruce confines basin open to the south						brown	water in confined basin,N of tussocky area.Little veg.@ shore
21A	med size	1-3m	sedge		sedge	along S shore			rocky on S shore		low %	rock ledge E shore		open to S Spr. to shore in W/N			P		steep @ ledge	brown	isolated basin
24	med size	flooded	sedge basin	to NW end		entire shore			can't see bottom	sparse lilies	5%			spruce to basin open to E shore			no			brown	isolated basin beside river

APPENDIX 2 continued

#	SIZE	EMERGENT VEGETATION: % COVER	SPECIES	DISTRIBUTION: 1 END	BOTH SHORE LINE	ENTIRE	CLUMPS	AQUATIC BED: MARL, ALGAE, ROCK	SUBMERGENT VEG: SPECIES	% COVER	SHORELINE	UPLAND VEGETATION: SHRUBS	SPRUCE: OPEN	SPRUCE: CLOSED	MIXED ASPEN/POPLAR	SNAGS	BEAVERS: DAM/HOUSE		SLOPE OF SHORE	H2O COLOUR	COMMENTS
26	med size	flooded SW	Carex meadow		sedge shore		tussocks on edge		sparse lily	95%			spruce to basin some in sedge			no		3	shore shallow		1 deep spot
26A	med size	>60% 30m edge	sedge	open to N			sedge tussocks	basin is sedge	lily/ other sparse	100%			black spr. to S spruce to N/S basin					1	shallow sloped shore	brown	channel into and out of water evidence of geese feeding-green stems/shoots on shore
50	med size	<1%						brown clay rock		<1%	willow on shore		standing dead around basin			P			mod all sides		old burn area, shallow pothole little shoreline development dead spruce/pine on N shore
31	<1 ha	flooded	sedge					clay	moss	small %	flooded willow		flooded dead throughout			lots	P	1 old	esker to N	dark brown	beaver bog; shallow, not much water
32	med size		sedge		thin meadow strip			mossy bottom			rocky shore	willow on shore	spruce to shore to south						mod to east	clear brown	waterbody in E edge of meadow large, shallow
34	>15 ha	very low	Carex		v thin @ edge			rock throughout		little seen			spruce to shore stunted						mod.	dark brown	large, shallow-deep in centre often waves during surveys
35	<1 ha	>50% sedge	flooded meadow					marl	moss	low%			spruce to basin standing dead			P	P	P			beaver bog, shallow, flooded sedge and channels
38	med size		Carex sedge		S,W meadow sides to W			rocks @ shoreline	centre moss/ other	low%	mixed sedge willow/spr. on N,E shore		spruce to shore 80% open/ spruce bog to south			no		2	mod to north	clear brown bottom	large, shallow, surrounded by open spruce. Narrow band of sedge between 38 & 38A
38A	med size		Carex		mostly in S			marl		low%	moss defined shoreline		spruce to shore							clear	shallow, many bays
38B	med size		Carex basin					algae/other submergents	moss algae	<2%	moss	shrub birch/ willow shore	open stunted sparse spruce							clear	flooded sedge basin-same as 38A-yellow bottom. Little spruce
40	med size	50%	sedge basin		Carex flooded sedge												1 old W end	2	slope to N spruce	dark	lots of sedge, oil on water in sedge also
41	med size	2-3m	sedge Carex	open S meadow	entire shore			dark moss/sub brown bottom					surrounded by spr./dead N shore					1 old		clear	isolated, outlet dammed, shallow small island
47	med size	low%	Carex	small meadow	E W shore			dark brown bottom	lilies @ S shore	70%			N spr. to shore some dead in sedge			lots		1		dark	shallow with channels lilies sparse through wetland

APPENDIX 2 continued

#	SIZE	EMERGENT VEGETATION						AQUATIC BED	SUBMERGENT VEG		SHORELINE	UPLAND VEGETATION			SNAGS	BEAVERS	SLOPE OF SHORE	H2O COLOUR	COMMENTS
		% COVER	SPECIES	DISTRIBUTION 1 END	BOTH SHORE LINE	ENTIRE	CLUMPS	MARL, ALGAE, ROCK	SPECIES	%COVER		SHRUBS	SPRUCE OPEN	SPRUCE CLOSED	MIXED ASPEN/POPLAR		BAR/HOUSE		
47A	<1 ha	10m to 5 2m to M	Carex sedge					moss	sparse lily	50%	moss		open black spruce to basin	@ shore	poplar beyond spr.			dark brown	small isolated pond in sedge meadow
47B	<1 ha	>50%	Carex meadow					vegetation			Carex	flooded to S	scattered spruce to shore	dead/	poplar beyond spruce		1 old	slope to north	waterbody at the base of hill flat elsewhere. Flooded meadows
50	med size	flooded sedge	extensive basin					sedge			sedge	shrub along river	scattered spruce	open		no		flat	clear	riparian. 3 waterbodies. S mostly sedge, middle sep. by hill/willow @ shore-watercress?